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ABSTRACT

This document is a supplement to the Annotated Bibliography of Human Factors Laboratory (HFL) Reports (1945-1968) and provides an abstract and complete bibliographic reference for each of the HFL's 68 publications for the years 1968-1972. The majority of these are reports of projects or research studies undertaken in connection with the HFL, usually focusing upon topics relating to training in general or to training people to perform tasks related to military operations. Studies on learning, retention, and transfer of training are examples of the former; research on ways of training personnel for operating and maintaining equipment and weapons are instances of the latter. The 68 citations are arranged in chronological crder and are followed by three indexes: Index by Source (contractor or in-house), Author Index, and Subject Matter Index. (PB)

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Technical Report: NAVTRAEQUIPCEN IH-158

ANNOTATED BIBLIOGRAPHY OF HUMAN FACTORS LABORATORY REPORTS (1945-1968) SUPPLEMENT #1, 1968-1972

Human Factors Laboratory
Naval Training Equipment Center
Orlando, Florida 32813

April 1973

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ABSTRACT

This document is a supplement to Annotated Bibliography of Human Factors Laboratory Reports (1945-1968), Technical Report: NAVTRADEVCEN IH-158, February 1969, AD 686174. It provides a complete bibliographic reference and an abstract for each of 68 publications of the Human Factors Laboratory from 1968 through 1972. The citations are arranged chronologically and are followed by three indexes: Index by Source (contractor or in-house), Author Index, and Subject Matter Index.

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Technical Report: NAVTRAEQUIPCEN IH-158

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Human Factors Laboratory

April 1973

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NAVAL TRAINING EQUIPMENT CENTER

ORLANDO, FLORIDA

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1968

1. Siegel, A. I. & Federman, P. J. Increasing ASW helicopter effectiveness through communications training: Final Report. NAVTRADEVCEN 66-C-0045-1, Contract N61339-66-C-0045, Applied Psychological Services, Inc. Oct. 1968, 190pp. AD 682498.

The verification of a prior factor analysis of communications, as a component of effective ASW helicopter performance, is described. Three of four previously isolated communications factors were found "congruent" with factors which emerged from the present study. A course, emphasizing the employment of the verified factors (as well as one additional factor) was developed, administered, and evaluated. The results indicated that participants in the course were significantly superior to a control group from the point of view of several operational criteria. These results are interpreted to suggest the utility and power of the course. Suggestions for fuller implementation of the course are presented.

2. Kurtz, A. K. & Smith, M. C. Annotated bibliography of Human Factors Laboratory reports (1945-1968). NAVTRADEVCEN IH-158, Naval Training Device Center. Feb. 1969, 369pp. AD 686174.

   A complete bibliographic reference and an abstract are given for each of the 765 publications of the Human Factors Laboratory from 1945 through 1968. The citations are arranged chronologically and are followed by three indexes: Index by Source (Contractor or in-house), Author Index, and Subject Matter Index. The latter consists of about 500 topics. Each of the 765 reports has at least four of these subject matter references; most reports have two or three times this many.

3. Bliss, William D. Visual simulation and image interpretation. NAVTRADEVCEN IH-153, Naval Training Device Center. Apr. 1969, 83pp. AD 856929.

   This report summarizes the available data on parameters affecting target recognition in dynamic image forming systems. The emphasis is on parameter values required for optimum performance in various types of simulations of visual systems. The report describes the various alternative ways in which visual systems can be simulated and discusses the merits and demerits of each system. Seventy-one research reports which purport to relate to the effect upon operator performance of variations in the parameters of image forming systems are analyzed.

4. Bonner, Leon T., Jr. & Parker, James F., Jr. Development of a military specification for NATOPS flight manuals. NAVTRADEVCEN 67-C-0165-1, Contract N61339-67-C-0165, BioTechnology, Inc. Apr. 1969, 278pp. AD 857294.

   The purpose of this study was to develop a Military Specification for NATOPS Flight Manuals. A prototype specification, NAVTRADEVCEN 1638-1, was evaluated and interviews and tests conducted with technical writers and Fleet flight personnel. Preferences, conditions of use, and technical data requirements were determined. A supporting technical report, NAVTRADEVCEN 67-C-0165-2, presents the final Military Specification for Preparation of NATOPS Flight Manuals.

5. Bonner, Leon T., Jr. & Parker, James F., Jr. Military specification for preparation of NATOPS flight manuals. NAVTRADEVCEN 67-C-0165-2, Contract N61339-67-C-0165, BioTechnology, Inc. Apr. 1969, 203pp. AD 857295.

   The purpose of this project was to develop a Military Specification for the preparation of NATOPS Flight Manuals. The specification is based on preferences, conditions of use, and requirements obtained from interviews, tests conducted with technical writers and Fleet flight personnel. A supporting technical report, NAVTRADEVCEN 67-C-0165-1, describes the development effort in detail.

6. DePauli, John F. & Parker, Edward L. The introduction of the Generalized Sonar Maintenance Trainer into Navy training for an evaluation of its effectiveness. NAVTRADEVCEN 68-C-0005-1, Contract N61339-68-C-0005, Human Factors Research, Inc. Apr. 1969, 16pp. AD 690604.

   The Generalized Sonar Maintenance Trainer, developed earlier, was introduced into the regular course of instruction at the Fleet Sonar School for an evaluation of its effectiveness. The research has two objectives: 1) to provide the School staff with the opportunity to evaluate the device independently, and 2) to conduct a comparative study of the learning and performance of students exposed to the trainer with that of students trained with existing facilities.

   Results of the comparative study showed that while the performance of control students was highly correlated with academic aptitude, the performance of the experimental students was totally unrelated to academic aptitude. It was concluded that the G. S. M. T. provides the means for lower aptitude trainees to perform as well as those with high aptitude, and that the G.S.M.T. is an effective aid to training. Conclusions of the Sonar School were forwarded directly to BuPers.

7. Schrenk, L. P., Daniels, R. W. & Alden, D. G. Study of long-term skill retention. (U) Final report. NAVTRADEVCEN 1822-1, Contract N61339-1822, Honeywell, Inc. Apr. 1969, 221pp. AD 503679. (The report is Confidential.)

   The purpose of this study was to investigate the long-term retention of team and individual ASROC/ASW skills as a function of type and amount of refresher training, amount of onboard training, and level

of personnel turnover during a 16-week retention interval. Preliminary recommendations to improve ASROC/ASW training, both ashore and at sea, are presented.

8. Jordan, Stephen. Eye movement research program: Annual report. NAVTRADEVCEN IH-166, Naval Training Device Center. Jul. 1969, 27pp. AD 694465.

   In the first section of the report the literature on technique and experimentation in eye movement research as it affects training device development is reviewed. In the second section the current program of the Human Factors Laboratory is described. This includes the preliminary experimentation on visual guidance techniques and the refinement of the electro-oculographic method of recording eye position. The last section is devoted to a description of future programs.

9. Hansen, Duncan N. & Dick, Walter. Memory factors in computer-controlled maintenance training. NAVTRADEVCEN 68-C-0071-1, Contract N61339-68-C-0071, Florida State University. Aug. 1969, 36pp. AD 697980.

   The purpose of this investigation was to explore those characteristics of training variables that might be incorporated into the design of computerized training devices and systems for or in Computer Controlled Training (CCT). The areas studied were: memory aids, computer controlled graphics, a CCT electronics circuit analysis course, and CCT training schedules. It was concluded that memory processes and related criterion performance were facilitated by graphic presentations via CCT; that the availability of CCT memory aids while applying complex concepts and relationships led to more accurate performance and a sixty-four percent savings in response time; that the feasibility of a CCT electronic circuit analysis training system having conceptual presentations from Boolean algebra, logic and set theory was established in that it is available on at least two different CCT systems; and that the systematic relation of correct responses and latencies suggest their further utilization for training decisions within CCT.

10. Bancroft, Norris R. & Duva, James S. The effects of adaptive stepping criterion on tracking performance: A preliminary investigation. NAVTRADEVCEN TN-3, Naval Training Device Center. Oct. 1969, 9pp. AD 698792.

The relationship between adaptive stepping criteria and learning and performance of psychomotor control skills was investigated. Comparisons were made between adaptive and non-adaptive training schedules, as well as among various adaptive stepping criteria. Hypotheses tested were that (1) adaptive training produces superior training than does non-adaptive training; and that (2) there is an "optimum" adaptive stepping criterion for any given task, or learning situation. Findings support both hypotheses, although results were not demonstrated to meet conventional levels of statistical significance. Recommendations were made for a follow-on study in the same area of interest.

11. Ozkaptan, Halim, Ohmart, James G., Bergert, James W., King, Barry C. and Clearfield, Warren H. Investigation of required television parameters for simulation of the pilot's visual world. NAVTRADEVCEN 68-C-0153-1, Contract N61339-68-C-0153, Martin-Marietta Corp. Dec. 1969, 138pp. AD 864382.

This report describes a series of tests designed to investigate resolution and target recognition performance under conditions of direct viewing and TV mediated viewing of appropriate test stimuli. The study utilized resolution bar charts and simple target forms, varying in target-to-background contrast. It was found that under idealized viewing conditions (when a high fidelity displayed image was simulated by viewing the display from an extended distance), the same visual relationships generally apply between direct and television viewing. Under normal television resolution limitations (experienced in a close viewing condition), an increase in target image size and/or contrast is required to permit visual resolution equivalent to that of direct viewing. It was concluded that the specific delineation of television simulation requirements will be a function of target complexity, with television resolution and S/N ratio playing a different role as target complexity increases.

12. DePauli, J. R. A study of the feasibility and desirability of developing a generalized underwater fire-control system maintenance trainer. NAVTRADEVCEN 69-C-0152-1, Contract N61339-69-C-0152, Human Factors Research, Inc. Jan. 1970, 43pp. AD 871547.

    The purpose of this research was to determine the feasibility and desirability of developing a Generalized Fire-Control System Maintenance Trainer to support training in basic maintenance and calibration of U. S. Navy underwater fire-control systems, and to determine the design and use characteristics of such a device. The research was based on the same concepts which led to the development of a Generalized Sonar Maintenance Trainer (NAVTRADEVCEN Device 14E22) and was accomplished using the same procedures; consequently the research had a second objective the further validation of the concept of generalized maintenance training.

    A sample of fire-control systems was analyzed in detail to establish their common functional and design characteristics, common maintenance requirements, and common maintenance training requirements. The findings were highly similar to those noted in the GSMT research. It was concluded that: (1) a GFCSMT was both feasible and desirable; and (2) the generalized maintenance trainer concept is definitely valid. It was recommended that: (1) an experimental model GFCSMT be constructed and evaluated before the design is "frozen"; (2) that the functional characteristics presented in the report be used as a guide for the experimental trainer; (3) that an "A3" phase of maintenance training be experimentally considered; and (4) that the generalized maintenance trainer concept be applied to other operational Naval systems.

13. Hammell, T. J. & Mara, T. D. Final report. Application of decision making and team training research to operational training: A translative technique. NAVTRADEVCEN 68-C-0242-1, Contract N61339-68-C-0242, General Dynamics, Electric Boat Div. Apr. 1970, 60pp. AD 871984.

    A technique was developed to translate findings of laboratory decision making research into a form applicable to the operational ASW/AAW training environment. This translative technique is composed of two categorization schemes - a decision skill taxonomy and a behavioral deficiency taxonomy - through which the experimental tasks studied and resultant research findings are translated. Applicability of the translated research findings to operational systems is demonstrated by an analysis of submarine fire control

data from training device and real-world exercises. Data and associated information from the operational analysis are classified and unpublished.

Observations indicated that decision making training could be implemented on existing devices, without the need for new hardware. A method of applying the translated findings, used in conjunction with proper training techniques, is offered as the means for implementing decision making training on both new and existing devices. Further operational application and validation are needed to refine these training procedures and demonstrate the applicability to tactical training systems.

14. Voss, H. A., Boney, W. B. & Rankin, W. C. Prototype instinctive firing training device for small arms. NAVTRADEVCEN IH-179, Naval Training Device Center. Apr. 1970, 15pp. AD 873014.

A prototype device for training skill in rapid firing of small arms by simply pointing the weapon at the target has been developed. The instinctive firing device (IFD) projects a beam of light which provides the trainee with immediate knowledge of results. Skill with the IFD is acquired quickly and transfers positively to the live ammunition situation. Safety, convenience, and cost-effectiveness of the IFD are readily demonstrable.

15. Siegel, A. I. & Federman, P. J. Development of a method for deriving required training aids/devices and application to the tactical coordinator position in ASW aircraft. NAVTRADEVCEN 68-C-0212-1, Contract N61339-68-C-0212, Applied Psychological Services, Inc. Jun. 1970, 176pp. AD 872267.

A method for deriving required training aids/devices for advanced systems is described and applied to the tactical coordinator's position in ASW aircraft. The method is based on an intellective analysis of the job in question and leads to a direct statement of the form of the aids/devices required. A method for calculating aid/device "appropriateness" is also given and the aids/devices believed required for tactical coordinator training are described.

16. Tallmadge, G. K. & Shearer, J. W. Study of training equipment and individual differences: Research on interactive relationships among learner characteristics, types of learning, instructional methods, and subject matter variables. NAVTRADEVCEN 68-C-0271-1, Contract N61339-68-C-0271, American Institutes for Research. Jun. 1970, 67pp. AD 871612.

This is the fourth in a series of research projects aimed at determining whether learning might be enhanced by employing instructional methods which differ in design and use as a function of learner characteristics. Based on inferences drawn from studies in this series and other research literature, a model was developed enabling the simultaneous examination of the effects of learner characteristics types of learning, instructional methods, and subject matter variables on achievement.

Each of six experimental courses was administered to between 57 and 60 Navy enlisted men who were previously tested with instruments which yielded a total of 39 measures of aptitude, interest, and personality characteristics.

Correlation and regression analyses revealed no consistent and meaningful interactive relationships existing between learner characteristics and types of learning or types of subject matter. These analyses did, however, reveal an apparently consistent and meaningful interaction between learner anxiety and method of instruction (inductive vs deductive). While the magnitude of the observed relationship was not sufficient to give promise of immediate practical application, it was concluded that that the research supported the existence of individual differences in learning style.

17. Leonard, J. N., Doe, L. H. & Hofer, J. L. Automated weapon system trainer. NAVTRADEVCEN 69-C-0151-1, Contract N61339-C-0151, Logicon, Inc. Jun. 1970, 328pp. AD 872854.

The aircraft weapon system training devices used at military training establishments place a considerable load on the instructor or operator who is in control of the device. Many of the tasks which are performed by the instructor or operator are repetitive and laborious. These tasks can be performed automatically by suitable programming of the computer used to control the operation of the training device.

The requirements of the flight simulator part of a typical aircrew training program were prepared by reviewing current aircrew

training programs and associated literature. The aircraft mission was divided into several different training areas and a recommended training approach selected from candidate approaches for each training area. The selected approaches are intended to be used for testing out training concepts and are not intended for use in a flight training program.

Design guides are presented which can be used to implement the recommended training approach for each training area. These design guides emphasize the automatic and adaptive nature of the recommended training approaches.

18. Blaiwes, A. S. A task classification approach to military training problems: A working paper. NAVTRADEVCEN IH-169, Naval Training Device Center. Jun. 1970, 39pp. AD 713888.

The major objective of this study was the development of a scheme which can be used as a guide to the generation and practical use of behavioral information. The report describes the rationale, methodology, and preliminary results of an effort to develop a systematic approach to the application and direction of psychological research to military training problems. Included in the study is a preliminary model for a new task taxonomy.

19. Dick, W., Rivers, L., King, A. D. & Hansen, D. N. Development of a model for adaptive training via computer-assisted instruction utilizing regression analysis techniques. NAVTRADEVCEN 68-C-0071-2, Contract N61339-68-C-0071, Florida State University. Jun. 1970, 44pp. AD 725466.

This research effort investigated the developmental procedures for producing a dynamic decision model for an ongoing learning situation via Computer-Assisted Instruction (CAI). The first step involved the exploration of the relationship between learning performance, latency, and subjective confidence ratings with quiz and final examination performance. The examination of the relationship was accomplished through correlational analyses. Based on these analyses an adaptive decision model was designed and implemented into the CAI learning materials. The adaptive decision model was shown to be effective in identifying those trainees who needed remedial instruction.

1970

20. Sidorsky, R. C. & Simoneau, G. R. Decision-making study. Final Report. An experimental evaluation of TACTRAIN: An approach to computer-aided tactical decision-making training. NAVTRADEVCEN 1329-4, Contract N61339-1329, General Dynamics Corp. June. 1970, 100pp. AD 875911.

    This is the final report of a study of generalized decision-making skills. The purpose of this project was to identify through both analytic and experimental means, the decision-making skills that are required for effective performance in AAW and ASW tactical situations.

    The project was divided into four phases; the results of the previous three phases are reported in three previous technical reports. This report documents the results of an experimental evaluation of a new decision-making trainer, TACTRAIN. The results of the experiment demonstrate the feasibility and utility of TACTRAIN as a developer of basic decision-making skills.

    The hardware and software of the prototype are described. The system was assembled to demonstrate that a relatively small computer (4096 24-bit words) and a computer-controlled CRT display system are sufficient to provide a fairly complex training situation. The device can be used as an adjunct to computer-aided instruction in the usual instructor-controlled training situation.

21. Blaiwes, A. S. & Regan, J. J. An integrated approach to the study of learning, retention, and transfer - a key issue in training device research and development. NAVTRADEVCEN IH-178, Naval Training Device Center. Aug. 1970, 47pp. AD 712096.

    The report summarizes the approach, rationale, and some of the results of an effort made at the Naval Training Device Center Human Factors Laboratory to acquire information on learning, retention, and transfer which can be applied toward the solution of military training problems. A review of some relevant psychological theories and an analysis of some of the relevant research literature are included.

1970

22. Brown, B. R., Hansen, D. N., Thomas, D. B. & King, A. D. Learner control of automated instruction. NAVTRADEVCEN 68-C-0071-3, Contract N61339-68-C-0071, Florida State University. Aug. 1970, 32pp. AD 728429.

In this study the effects of four variations of learner control and one instructor control condition were investigated. The four types of learner control chosen for the investigation were (1) selection of media-device, (2) selection of information load, (3) selection of repetition by branching, and (4) selection of topic sequence.

Significant pre-post improvement was observed across all groups. However, learner control did not improve performance in comparison to the no learner control group. Subjects did choose device redundency level combinations which tended to optimize the memory load of the device and material combination.

23. Lamb, J. C., Bertsche, W. R. & Carey, B. G. A study of a generalized advanced casualty ship control training device. Vol. I of II, Study findings. Vol. II of II, Appendices A through D. NAVTRADEVCEN 69-C-0117-1, Contract N61339-69-C-0117, General Dynamics Corp. Aug. 1970, 297pp. AD 878836.

This study was designed to (1) evaluate the feasibility of providing multi-class emergency ship control training by means of a generalized casualty control training device, (2) derive detailed functional characteristics for such a device, and (3) determine the implications of this concept for the Navy's existing submerged ship control training program. This was accomplished by the use of task/system analysis techniques to assess the degree of commonality among the various classes of nuclear submarines with respect to potential casualty situations, the criticality of display and control elements, and the characteristics of the personnel to be trained. Composite requirements for advanced casualty control simulation and training in all classes of Nuclear Attack and Ballistic Missile Submarines were derived and used as the basis for determining the specific functional characteristics of a proposed generalized training system.

It was concluded that (1) the development of a generalized submarine casualty control device for multi-class emergency ship control training is technically feasible, and (2) a generalized training system based on the functional characteristics identified in this study would meet the Navy's needs in a cost-effective manner.

1970

24. Blaiwes, A. S. Transfer as a function of task difficulty in pursuit-rotor and paired associate learning. NAVTRADEVCEN IH-172, Naval Training Device Center. Oct. 1970, 46pp. AD 714841.

The focus of the research reported here has been on the investigation of the generality of psychological findings across different kinds of tasks. The approach taken was to compare the influence of task difficulty on the performance in training and transfer of a paired-associate and pursuit-rotor task.

The report documents some of the difficulties connected with empirical attempts to answer the question of whether variables affect learning in the same way on different tasks. The report also points out some problems with the concept of "task difficulty." Suggestions for remedying these difficulties are given.

25. Puig, J. A. Motion in flight training: A human factors view. NAVTRADEVCEN IH-177, Naval Training Device Center. Oct. 1970, 57pp. AD 880445.

An in-house study was conducted to review the status of simulation technology as applied to training, with emphasis on human factors problems encountered in motion simulation. The effect of incorporating motion in ground-based visual simulators was considered with respect to its influence on training and its role as a possible inhibitor of simulator sickness. The position of the Human Factors Laboratory was expressed on several aspects of simulation related to training technology.

26. Jeantheau, G. G. Handbook for training systems evaluation. (U) NAVTRADEVCEN 66-C-0113-1, Contract N61339-66-C-0113, Dunlap and Associates, Inc. Nov. 1970, 127pp. AD 512675. (The report is Confidential.)

The handbook presents the procedures for conducting evaluations of the effectiveness of training in training devices. Four levels of evaluation are treated: qualitative assessment, non-comparative measurement, comparative measurement, and transfer of training. Each succeeding level provides increasing rigor but also entails increased problems of coordination and cooperation with the training activity. A field trial of the method with Device 21A39, Submarine Attack Teacher, is discussed and examples of materials and procedures are given. Recommendations are included for application of the method to other training device settings.

1970

27. Byrd, K., Kidd, J. S. & Price, H. E. Analysis and evaluation of Navy avionics manuals. NAVTRADEVCEN 69-C-0301-1, Contract N61339-69-C-0301, BioTechnology, Inc. Dec. 1970, 58pp. AD 880414.

The purpose of this study was to identify specific inadequacies in aircraft maintenance manuals and to recommend ways and means for their correction. To this end, avionics maintenance technicians were sampled by questionnaires and interviews, and representative aircraft maintenance manuals were critically analyzed. Respondents were questioned concerning information requirements and were asked to comment on the physical characteristics of the handbooks. Specific problem areas dealt with such factors as format, organization, graphics, readability, level of explanation, utilization procedures, and revision problems. This report contains an overview of the project analysis and specific statements of existing problems as identified by user views with accompanying analyses and recommendations.

28. Klier, S. & Gage, H. Motion factors in flight simulation. NAVTRADEVCEN 68-C-0007-1, Contract N61339-68-C-0007, Grumman Aerospace Corp. Dec. 1970, 46pp. AD 880341.

A study was performed to investigate the effect of different simulator motion conditions on pilot performance. It was intended to explore the cueing function of simulator motion. Subjects were required to perform a simulated air-to-air gunnery task under four conditions of motion where the frequency components of such motion inputs were limited to 0 Hz (no motion), 0-1.0 Hz, 0-2.5 Hz, 0-3.5 Hz, respectively. These conditions were hypothesized to interact differentially with concomitant visual motion cues. Results of performance accuracy (e.g., percent time-on-target) indicated a tendency for the order of conditions from best to worst to be 0-2.5 Hz, 0-1.0 Hz, 0-3.5 Hz, 0 Hz. However, the treatment effects did not meet the predetermined level of statistical significance. Simulator motion produced better accuracy performance than no motion. There was a significant learning or practice effect as a result of continued exposure to the task. Other performance parameters showed no systematic differences as a function of experimental condition. These variables may have been affected by "noise" in the response of the motion platform which tended to mitigate differences among the experimental conditions. In general, the results of this study appear to confirm indications in previous studies that simulator motion need not be a faithful reproduction of real-life motion in order to provide essential motion cues.

1970

29. Krumm, R. L. & Buffardi, L. Training effectiveness evaluation of Naval training devices. Part I: A study of submarine diving trainer effectiveness. NAVTRADEVCEN 69-C-0322-1, Contract N61339-69-C-0322, Bunker-Ramo Corp. Dec. 1970, 46pp. AD 879712.

    SSN613 and SSBN627 submarine diving trainers were evaluated during a five-week indoctrination course at the U. S. Navy Submarine School. A standard exercise was administered during each of seven training sessions. Student officers maintained depth during speed and buoyancy changes, and changed to new ordered depths. Performance of 16 student groups was compared with the performance of five experienced crews. Student performance approached 90% of experienced crew performance by the seventh training session for easier maneuvers but was less than 50% of experienced crew performance for more difficult maneuvers. Recommendations are offered concerning simulator utilization in indoctrination courses.

30. Ruocco, J., Klier, S., Gage, H. & Vitale, P. Design factors in environmental simulation. NAVTRADEVCEN 66-C-0019-1, Contract N61339-66-C-0019, Grumman Aircraft Engineering Corp. Dec. 1970, 69pp. AD 880048.

    This study was conducted to investigate the relationships between various aspects of cockpit motion and pilot performance. The task of landing approach was carried out by experienced pilots both in the simulator and in the aircraft. The results of the experiment indicated that (1) both experimental apparatus and design variables operated to limit the conclusions to be drawn from the study, (2) comparisons between pilot performance in the simulator and the actual aircraft were possible but not meaningfully related to the experimental questions, (3) with respect to the test of the relationships between pilot performance and variations in the motion characteristics, meaningful conclusions were not possible because of experimental apparatus and design difficulties. The study provided valuable knowledge for definition and quantification of simulator motion which should prove useful in future investigations of the effect of simulator motion upon performance and transfer of training.

31. King, B. C., Fowler, F. D. & Warner, R. P. Study, perceptually similar visual environment - Final report. NAVTRADEVCEN 69-C-0188-1, Contract N61339-69-C-0188, Martin Marietta Corp. Dec. 1970, 161pp. AD 881976.

NAVTRAEQUIPCEN IH-158

1970

This report describes a series of tests with application to TV simulation of representative real-world targets. Resulting data are presented comparing TV mediated and direct visual recognition of sheds and missile launchers. Use of a variable parameter TV system permitted the definition of a high fidelity TV mode in which displayed noise effects are insignificant. These two viewing modes are equated by means of a TV system parameter, viz., active scan lines across the target image. This parameter appears to play a major role in determining displayed target image sizes required for threshold recognition.

1971

32. Jeantheau, G. G. Handbook for training systems evaluation. NAVTRADEVCEN 66-C-0113-2, Contract N61339-66-C-0113, Dunlap and Associates, Inc. Jan. 1971, 76pp. AD 885751.

The handbook presents the procedures for conducting evaluations of the effectiveness of training in training devices. Four levels of evaluation are treated: qualitative assessment, non-comparative measurement, comparative measurement, and transfer of training. Each succeeding level provides increasing rigor but also entails increased problems of coordination and cooperation with the training activity. A field trial of the method with Device 21A39, Submarine Attack Teacher, is discussed and examples of materials and procedures are given. The classified version provides a fuller treatment of this application. (NAVTRADEVCEN 66-C-0113-1). Recommendations are included for the application of the method to other training device settings.

33. Wheaton, G. R., Mirabella, A. & Farina, A. J., Jr. Trainee and instructor task quantification: Development of quantitative indices and a predictive methodology. NAVTRADEVCEN 69-C-0278-1, Contract N61339-69-C-0278, American Institutes for Research. Jan. 1971, 116pp. AD 722423.

This was an exploratory study to develop quantitative techniques for prescribing the design and use of training systems. As a first step, the study (1) compiled an initial set of quantitative indices, (2) determined whether these indices could be used to describe a sample of trainee tasks and differentiate among them, (3) developed a predictive methodology, and (4) assessed that methodology using studies in the literature.

The compilation included the Display-Evaluative Index, a set of panel lay-out indices, and a set of task rating scales. These indices were applied to task analytic data, and the application proved feasible. Differentiation among three training devices, and within four trainee sub-tasks (set-up, detection, localization, classification) was possible.

The predictive method was an adaptation of the standard multiple regression model. Mean task scores replaced the usual individual criterion scores, and quantitative task index values were used as predictor scores. This adaptation was tested using data from published studies on tracking.

1971

34. Baron, S., Levison, W. H., Nickerson, R. S., Sutherland, W. R. & Thomas, E. L. Development of behavioral science programming language. NAVTRADEVCEN 70-C-0046-1, Contract N61339-70-C-0046, Bolt Beranek and Newman, Inc. Feb. 1971, 54pp. AD 726432.

Design criteria and an implementation plan are specified for a Behavioral Science Programming Language (BSPL) to be used for programming experiments on the computer-driven, high-performance aircraft simulation facility at NTDC. The BSPL was conceptualized with the following goals in mind: (a) the language should take full advantage of the existing hardware and software facilities: (b) it should be rich enough in structure to allow the programming of meaningful experiments, yet simple enough to be readily learned by the non-programmer; (c) it should be usable by individuals who do not have intimate knowledge of the simulation program: (d) it should be incrementally implementable; and (e) it should be capable of graceful expansion and elaboration.

The language requirements are determined in large part by the nature of the existing facility on the one hand, and the types of experiments that are contemplated on the other. This report begins, therefore, with a description of the present facility, a conceptualization of a prototype experiment, and the implication of these factors for the design of the BSPL. A proposed design is then presented along with an implementation plan. The plan partitions the development of the language in such a way that incremental improvements in the facility can be realized as the plan is carried out. A formal description of the language and a sample program are included as appendices.

35. Bernstein, B. R. & Gonzalez, B. K. Learning, retention and transfer. Vol. I of II. NAVTRADEVCEN 68-C-0215-1, Contract N61339-68-C-0215, Honeywell, Inc. Feb. 1971, 216pp. AD 724778.

Requirements were established for a long-term program of learning, retention and transfer research, and two initial experiments were conducted to provide a data base for subsequent investigations. Results suggested that imagery can play an important role in promoting procedural skills, and that training effectiveness can be achieved by use of low-cost pencil and paper simulation of the operational task.

1971

36. Bernstein, B. R. & Gonzalez, B. K. Learning, retention and transfer, Appendix B: L, R, and T technical meetings report, Vol. II of II. NAVTRADEVCEN 68-C-0215-1, Contract N61339-68-C-0215, Honeywell, Inc. Feb. 1971, 187pp. AD 724790.

This volume consists of the proceedings of a meeting of consultants for a project on Learning, Retention and Transfer in military training. Topics discussed included the following: (1) Research strategy for learning, retention and transfer; (2) Learning, retention and transfer research and computer-aided instruction; (3) Training for vigilance: Some suggestions for research on the learning, transfer and retention of watch-keeping skills; (4) The learning, retention, and transfer of decision making; (5) The learning, retention, and transfer of pattern recognition; and (6) Learning, retention, and transfer of procedure-following skills: Some perspectives from research on verbal learning.

37. Vreuls, D. & Obermayer, R. W. Study of crew performance measurement for high-performance aircraft weapon system training: Air-to-air intercept. NAVTRADEVCEN 70-C-0059-1, Contract N61339-70-C-0059, Manned Systems Sciences, Inc. Feb. 1971, 218pp. AD 727739.

This study was undertaken to develop performance measurement and methods for deriving performance measurement for F-4J air-to-air intercept training in an envisioned adaptive and automated training environment. It was found that a combined analytic-empirical test method was mandatory for defining performance measurement for adaptive training. Functional relationships between measures, tasks and adaptive variables must be known to design adaptive logic. A measurement set for the pilot, the radar intercept officer, and the crew were analytically derived. Limited measurement tests were conducted.

38. Hammell, T. J., Sroka, F. P. & Allen, F. L. Study of training device needs for meeting basic officer tactics. Vol. I of II. NAVTRADEVCEN 69-C-0140-1, Contract N61339-69-C-0140, General Dynamics Corp./Electric Boat Division. Mar. 1971, 90pp. AD 726428.

This study was conducted to (1) identify tactical training needs and objectives of basic submarine officer personnel assigned to SSN and SSBN class submarines; (2) identify specific requirements for

training materials which will meet the training objectives; and (3) provide functional requirements for recommended training devices. An operational analysis determined the job requirements, in terms of skills and knowledge, for each member of the fire control party. (The task analysis and skill and knowledge requirements are contained in a Classified Supplement, NAVTRADEVCEN 69-C-0140-1, Vol. II). Training objectives were determined from the skill and knowledge requirements, in conjunction with trainee input and output characteristics.

Training techniques and devices are recommended to meet the training objectives. The ability of existing facilities to meet the recommended device needs is discussed, and modifications are recommended. Finally, additional training devices are recommended to fulfill the needs not met by existing facilities. These new devices consist of a generalized individual trainer and a periscope visual task trainer.

39. Hammell, T. J., Sroka, F. P. & Allen, F. L. A study of training device needs for meeting basic officer tactics training requirements, Final Report. Vol. II of II (Classified Supplement). NAVTRADEVCEN 69-C-0140-1, Contract N61339-69-C-0140, General Dynamics Corp. / Electric Boat Division. Mar. 1971, 144pp. AD 516714. (The report is Confidential.)

    This is the classified supplement to Technical Report NAVTRADEVCEN 69-C-0140-1, of the same title.

    Section 1 contains a task analysis of the fire control party on a nuclear submarine, using MK 113 fire control system. Included are the tasks of the OOD as they pertain to the contact phase of an attack. The task type and criticality and interaction means/mode and criticality are included for each task. Section 2 contains a list of knowledge and skills, and the respective levels thereof, required of each operator in the fire control party.

40. Matheny, W. G., Lowes, A. L., Baker, G. & Bynum, J. A. An investigation of visual, aural, motion and control movement cues. NAVTRADEVCEN 69-C-0304-1, Contract N61339-69-C-0304, Life Sciences Inc. Apr. 1971, 100pp. AD 726430.

    This report is devoted to the determination of how multi-sensory cues can be simulated and effectively used in the training of pilots.

An analytical basis and cue taxonomy is developed and cues are postulated on the basis of information gained from the outside world, from sounds generated by the aircraft, and from cues resulting from aircraft motion and control movements. Description and measurement of the physical characteristics of the postulated cues are emphasized. Hypotheses are developed based upon the effects of postulated cues as they both function independently and interact with cues in other modalities. Experimentation is recommended which will lead to verification or modification of cue postulation.

41. Clovis, E. R., Chiorini, J. R., Kushnick, S. A., Covell, D. E., Duffy, J. O., and Tiller, L. S. A study of training device requirements to support land combat training: Vol. I - recruit training. Final Report. NAVTRADEVCEN 69-C-0215-1, Contract N61339-69-C-0215, Litton Systems, Inc. Apr. 1971, 123pp. AD 894317.

What are the needs for training devices and device systems in Marine Corps Land Training? Defense Sciences Laboratories addressed this question in an investigation of the training needs of four components of Marine Corps Land Combat Training: Recruit Training; Individual Combat Training; Basic Specialist Training (Infantry); and Officer Tactical Training. The report is in three volumes. This volume, Volume 1, presents: the procedures followed in the investigation for the training devices and device systems required to support the Recruit Training component; the results of the investigation; and recommendations. In particular, this report describes in detail (1) the method developed for determining training device requirements from a consideration of training objectives and instructional methodology; and (2) the training devices needed to support selected courses. The investigation revealed the need for a number of new training devices including marksmanship training support systems, and certain large-scale equipment mock-ups. Also relevant were the needs for a standardized course to prepare training instructors and a central agency to determine training objectives, lesson plans, and training device specifications.

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42. Clovis, E. R., Chiorini, J. R., Kushnick, S. A., Covell, D. E., Duffy, J. O., and Tiller, L. S. A study of training device requirements to support land combat training: Vol. II - individual combat training and basic specialist training. Final Report. NAVTRADEVCEN 69-C-0215-2, Contract N61339-69-C-0215, Litton Systems, Inc. Apr. 1971, 185pp. AD 894318.

    What are the needs for training devices and device systems in Marine Corps Land Combat Training? Defense Sciences Laboratories addressed this question in an investigation of the training needs of four components of Marine Corps Land Combat Training: Recruit Training; Individual Combat Training; Basic Specialist Training (Infantry); and Officer Tactical Training. This report is in three volumes. This volume, Volume II, presents: the procedures followed in the investigation of the training devices and device systems required to support the Individual Combat Training and Basic Specialist Training components; the results of the investigation; and recommendations. In particular, this report describes in detail (1) the method developed for determining training device requirements from a consideration of training objectives and instructional methodology; and (2) the training devices needed to support selected courses. The investigation revealed the need for a number of new training devices including closed circuit television, rifle marksmanship training support systems, and certain large-scale equipment mock-ups. Also revealed were the needs for a standardized course to prepare training instructors and a central agency to determine training objectives, lesson plans, and training device specifications.

43. Clovis, E. R., Chiorini, J. R., Kushnick, S. A., Covell, D. E., Duffy, J. O., and Tiller, L. S. A study of training device requirements to support land combat training: Vol. III - officer tactical training. Final Report. NAVTRADEVCEN 69-C-0215-3, Contract N61339-69-C-0215, Litton Systems, Inc. Apr. 1971, 227pp. AD 894319.

    What are the needs for training devices and device systems in Marine Corps Land Combat Training? Defense Sciences Laboratories addressed this question in an investigation of the training needs of four components of Marine Corps Land Combat Training: Recruit Training; Individual Combat Training; Basic Specialist Training (Infantry); and Officer Tactical Training. This report is in three volumes. This volume, Volume III, presents: the procedures followed in the investigation of the training devices and

device systems required to support the Officer Tactical Training components; the results of the investigation; and recommendations. In particular, this report describes in detail (1) the method developed for determining training device requirements from a consideration of training objectives and instructional methodology; and (2) the training devices needed to support selected courses. The investigation revealed the need for a number of new training devices including computer-assisted instruction systems, closed circuit television, rifle marksmanship training support systems, and certain large-scale equipment mock-ups. Also revealed were the needs for a standardized course to prepare training instructors and a central agency to determine training objectives, lesson plans, and training device specifications.

44. Bowen, H. M. & Hale, A. Study, feasibility of undersea salvage simulation. NAVTRADEVCEN 69-C-0116-1, Contract N61339-69-C-0116, Dunlap and Associates, Inc. May 1971, 90pp. AD 726427.

The study reviews man's involvement in undersea salvage operations as conducted by the Navy and defines the relevant training requirements. A considerable variety of surface ships, submersibles, diving systems and underwater tools is available. A descriptive model of the mobilization of these resources at a salvage site is offered. The following recommendations are derived from this descriptive model:

Divers must be trained in water; hence, training tanks are required. Suitable facilities are described.

Underwater systems require the carrying out of complex procedures and skilled tasks; appropriate simulators to train the required skills are necessary.

Salvage, from the point of view of the on-scene commander and his staff, is a problem-solving operation. Training is necessary and may be conducted by means of a model, an on-line computer, and scenarios depicting salvage situations.

45. DePauli, J. F. Design characteristics of a digital sonar maintenance trainer: An adjunct to Device 14E22. NAVTRADEVCEN 69-C-0268-1, Contract N61339-69-C-0268, Human Factors Research, Inc. Jun. 1971, 45pp. AD 729029.

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This study was conducted to determine the design characteristics of an advanced sonar unit to be used as an adjunct to Device 14E22 (Generalized Sonar Maintenance Trainer). A study was made of the functional and design characteristics of recently developed sonar systems, sonar design trends, and the state-of-the-art in general electronics.

It was concluded that new technology sonars such as the SQQ-23 and SQS-26 series equipments differ significantly from older systems in that they represent the advent of a new era in sonar design, that of the solic-state digital sonar. It was also concluded that an advanced digital sonar maintenance trainer was needed as an adjunct to Device 14E22 and that such a device would be a valuable asset to sonar school instructors.

The report describes the recommended design characteristics of a digital sonar maintenance trainer. It is recommended that an experimental model of the device be constructed and evaluated.

46. Meister, D., Sullivan, D. J., Thompson, E. A. & Finley, D. L. Training effectiveness evaluation of Naval training devices, Part II. A study of Device 2F66A (S-2E trainer) effectiveness. NAVTRADEVCEN 69-C-0322-2, Contract N61339-69-C-0322, Bunker-Ramo Corp. Jul. 1971, 103pp. AD 732795

This study examined the effectiveness of Device 2F66A (S-2E trainer) in training crew members to perform air antisubmarine warfare missions. Results generally indicated that the trainer was effective with all crew members, that beginning students benefited more than operational and reserve personnel, and that important improvements in training for all personnel could be effected through systematic utilization of existing training devices. Recommendations for improved use of existing capabilities included: more systematic variations of the training session, increased trainer usage, and more systematic utilization of the trainer in both individual and team modes.

47. Bernstein, B. R. & Gonzalez, B. K. Learning, retention and transfer in military training. NAVTRADEVCEN 69-C-0253-1, Contract N61339-69-C-0253, Honeywell, Inc. Sep. 1971, 82pp. AD 788964.

Investigations into the role of imagery and fidelity of simulation on learning, retention and transfer were conducted. These

experiments were part of a long range program leading to improved training methods for the Navy. Imagery did not have a consistently beneficial effect on transfer performance. Relatively high levels of training effectiveness resulted for procedural tasks in the absence of high physical fidelity between training and transfer conditions.

48. DePauli, J. F. Design characteristics of a generalized fire-control system maintenance trainer (GFCSMT). NAVTRADEVCEN 70-C-0249-1, Contract N61339-70-C-0249, Human Factors Research, Inc. Sep. 1971, 48pp. AD 733963.

    The purpose of this investigation was to develop detailed design characteristics for a Generalized Fire-Control Maintenance Trainer (GFCSMT) to support training in basic maintenance and calibration of U. S. Navy underwater fire-control systems. The objective of the project was to refine the functional design characteristics presented in an earlier report (NAVTRADEVCEN 69-C-0152-1) and to establish an optimal physical configuration for the trainer. Perspective and plan-view drawings depicting various training features and trainer configurations were developed and used as a focal point for interviews with fire-control instructor personnel. The design presented in this report reflects a consensus of both instructors and HFR personnel regarding the optimal configuration for a GFCSMT. It was concluded that (1) a suitable training device would contribute significantly to the effectiveness of fire-control system maintenance training, and (2) the functional and physical design for a GFCSMT presented in this report is well suited to the objective of improving the effectiveness of FCS maintenance training. It was recommended that (1) an experimental model GFCSMT be constructed and evaluated using the recommended design characteristics presented, and (2) an "Instructor Guide to the GFCSMT be prepared concurrently.

49. Parker, E. L. Application and design characteristics of generalized training devices. NAVTRADEVCEN 70-C-0309-1, Contract N61339-70-C-0309, Anacapa Sciences, Inc. Sep. 1971, 98pp. AD 733471.

    The objectives of this study were (1) to identify applications for generalized training devices, and (2) to forecast the impact on generalized training devices of new developments in Naval electronic equipment, maintenance procedures, and training techniques. The first phase was a review of developments in equipment technology that influence the design of maintenance

training devices. The second phase had two objectives: (1) to examine present training practices in electronic maintenance, and (2) to identify skill and knowledge requirements created by Naval systems now in the development cycle. As a result three generalized training devices were recommended: (1) a digital system training device, (2) a communications system training device, and (3) a generalized torpedo maintenance training device. The objective of the third phase was to develop the design and use characteristics of the three recommended training devices with particular emphasis on the digital systems trainer. Each device is developed to the functional block diagram level and its role in Naval training is described, including the school(s) for which it was intended.

Finally, recommendations are made for the inclusion of computer-assisted instruction as related to the digital systems trainer.

50. Smode, A. F. Human factors inputs to the training device process. NAVTRADEVCEN 69-C-0298-1, Contract N61339-69-C-0298, Dunlap and Associates, Inc. Sep. 1971, 578pp. AD 734644.

This report presents guidelines for achieving human factors inputs to the design of synthetic training systems. It provides a method for design and organizes training concepts and data supportive to the human factors specialist in deriving the functional specifications for the design of any complex training device. Three major sections are provided. The first presents an organized method for achieving human factors inputs to training system design. Another section presents concepts and data applicable to the design of training devices. Seven content chapters are subsumed under this section: (1) visual simulation, (2) platform simulation, (3) vehicle control requirements, (4) information processing requirements, (5) measurement system design, (6) adaptive training strategies, and (7) deliberate departure from realism in design. For each chapter concepts and data which provide human factors design support are articulated based on a review of the pertinent literature. Where design evidence is meager, the data gaps are identified. Research issues of high priority for human factors design are recommended. The final section provides a demonstration of the human factors design process for a complex training system.

1971

51. Jeantheau, G. G. Training device employment materials. NAVTRADEVCEN 70-C-0189-1, Contract N61339-70-C-0189, Dunlap and Associates, Inc. Nov. 1971, 76pp. AD 733962.

The results of a survey of training device materials are reported. Approximately 100 sets of materials were evaluated. Analysis of materials revealed a wide diversity in approach to device use and significant differences in treatment of materials for trainers in the same general class. Included are criteria for effective device use and effective device materials. Examples of noteworthy materials are provided.

52. Annett, John. Sonar recognition training: An investigation of whole vs. synthetic procedures. NAVTRADEVCEN 67-C-0105-1, Contract N61339-67-C-0105, The University of Hull. Dec. 1971, 62pp. AD 671842.

A series of experiments is described in which 15 methods of teaching identification of complex sonar-like sounds were compared. These include whole and part methods in which subjects were trained on samples of whole sounds, received pre-training on components of the sound or were exposed to components in the context of whole sounds. The conditions included variations in order in which training items were presented and in the kinds of verbal instruction given.

1972

53. Thomas, Rex C. Motivation in training: A study of incentives. NAVTRADEVCEN TN-10, Naval Training Device Center. Jan. 1972, 10pp. AD 739330.

An investigation was performed concerning the effects of three levels of incentives upon two levels of task difficulty. The hypothesis tested was that a monetary incentive would induce an individual subject to perform in a manner superior to his peers. The monetary incentive was employed as a means of encouraging acceptance of the error level goal which subjects were given as being the performance level obtained by their peers. The findings were in the desired direction but non-significant, probably due to subjects failure to accept the goal as their own.

54. Charles, John P., and Johnson, R. M. Automated trainer evaluation. Final Report. NAVTRADEVCEN 70-C-0132-1, Contract N61339-70-C-0132, Logicon, Inc. Jan 1972, 154pp. AD 736932.

A technical feasibility demonstration of automated training on a flight simulator was conducted. The training tasks were the Ground Controlled Approach and two in-flight emergencies. The training device computer system at the Naval Training Device Center was utilized for the tests. Twelve operational F-4 pilots served as subjects. The difficulty of the runs was varied and adaptively controlled by pilot performance.

55. Daniels, R. W., Alden, D. G., Kanarick, A. F., Gray, T. H., and Feuge, R. L. Automated operator instruction in team tactics. Final Report. NAVTRADEVCEN 70-C-0310-1, Contract N61339-70-C-0310, Honeywell, Inc. Jan. 1972, 60pp. AD 736970.

The objective was to determine the feasibility of training team tactics using advanced techniques such as adaptive or generalized training. The commonality of team tasks accomplished in air, surface and submarine tactics trainers was identified using a numerical task taxonomy. Task commonality data were analyzed to identify the most appropriate training techniques. Recommendations are made for the application of advanced techniques to training tactical teams and subteams.

1972

56. Norman, D. A., Lowes, A. L., and Matheny, G. W. Adaptive training of manual control: 1. comparison of three adaptive variables and two logic schemes. Final Report. NAVTRADEVCEN 69-C-0156-1, Contract N61339-69-C-0156, Life Sciences, Inc. Jan. 1972, 54pp. AD 736621.

    Gain-Effective Time Constant product (KT) System Compensation (a condensation of aiding and quickening (SC) and Forcing Function Amplitude (FF) were compared as adaptive variables in an adaptive training experiment using 104 subjects. Comparison was also made of Automatic and Manual adjustment of the difficulty level determined by the level of the adaptive variables during training. Results showed KT to be slightly superior to FF as an adaptive variable while SC produced poor performance and a high rate of failure. Study of the results suggest that principles underlying KT and a correct form of SC can be used to develop an optimal method of shaping operator behavior. It was concluded that conventional concepts of aiding and quickening cannot be implemented as satisfactory adaptive variables. The results were additionally interpreted to indicate that logic for adjustment of difficulty level should utilize a performance measurement interval longer than 5 seconds.

57. Jordan, S. and Manfredi, U. Eye movement research program, annual report no. 2; visual training. Final Report. NAVTRADEVCEN IH-202, Naval Training Device Center. Mar. 1972, 42pp.

    In a series of experiments, significant improvements were found in ocular pursuit tracking with practice. These improvements, which held for various directions of tracking, endured beyond the training period. Also, the effect of ocular pursuit training on subsequent performance in a variety of visual-motor tasks was studied. In two transfer of training experiments, a high degree of positive transfer was found in the first but not in the second study.

58. Siskel, M. Auxiliary devices in high performance aircraft weapons system training. Final Report. NAVTRADEVCEN TN 70-C-0047-1, Contract N61339-70-C-0047, Ling Temco Vought Aerospace Corp. May 1972, 100pp. AD 901026.

    The objective of this study was to examine a typical training program centered about the weapon system trainer for a high

performance airplane and identify potential improvements in the form of new training methods and auxiliary training devices. Relevant information was acquired from operations and research publications and familiarization with Naval F-4 training programs and with commercial flight training practices. Crew-member task data and device applications information were consolidated to yield functional descriptions of five auxiliary devices which should improve the WST training program.

59. Ryan, L. E., Puig, J. A., Micheli, G. S., and Clarke, J. C. An evaluation of the training effectiveness of Device 2F90. Final Report. NAVTRAEQUIPCEN IH-207, Naval Training Equipment Center. Aug. 1972, 53pp. AD 750248.

    The training effectiveness of the TA-4J advanced jet trainer (Device 2F90) was evaluated by measuring transfer of training from the trainer to the operational situation. Comparisons were made among three experimental and a control group (which received the normal syllabus training). Of the experimental groups, one received training in flight, another group only in the trainer, and the third received only academic training on related principles of the basic instrument portion of the syllabus. Following training, all groups were given a checkride in the aircraft. The relative benefits of the different types of training were evaluated to determine the effectiveness of the trainer in training advanced naval aviation students in the B stage (Basic Instruments) of the NAVJIT (Naval Jet Instrument Trainer) syllabus for the TA-4J aircraft. The study demonstrated that 4.4 hours of aircraft flight time per student could be saved by substituting trainer time for aircraft time in the B stage; a significant cost savings when considering the 450 students that are processed through the school annually.

60. Smode, A. F. Training device design: human factors requirements in the technical approach. Final Report. NAVTRAEQUIPCEN 71-C-0013-1, Contract N61339-71-C-0013, Dunlap & Associates. Aug. 1972, 280pp. AD 754744.

    This report presents guidelines for achieving the human factors inputs to the Technical Approach in the training device design process. A method is provided which facilitates the correlation of instructional requirements with engineering design solutions. Techniques and procedures are recommended for organizing the information requirement which must be accounted for in the

engineering design in order to maximize the instructional potential of a device. Three major sections are provided. The first of these presents techniques and procedures for deriving the information requirements relative to achieving simulation fidelity in trainee station design. The second section presents procedures for deriving the information requirements involved in setting up controlling, monitoring and evaluating performance at the instructor station. Fourteen chapters describe the information requirements pertinent to the structure and control of training during the off-line, pre-mission enroute training and post-exercise operations. The last section discusses the human factors test and evaluation requirements in the training device acceptance process. Procedures are outlined for verifying the suitability of a training device as an instructional system. The test, evaluation and demonstration requirements throughout device fabrication are organized to assist the human factors specialist in determining that the device performs as advertised.

61. Finley, D. L., Rheinlander, T. R., Thompson, E. A. and Sullivan, D. J. Training effectiveness evaluation of naval training devices part I: a study of the effectiveness of a carrier air traffic control center training device. Final Report. NAVTRADEVCEN 70-C-0258-1, Contract N61339-70-C-0258, Bunker-Ramo. Aug. 1972, 110pp.

This study evaluated the effectiveness of the Carrier Air Traffic Control Center (CATCC) training device in training teams to satisfy and efficiently control aircraft recoveries and to effectively maintain communications necessary to implement this control function. The results indicate the device is quite effective in that team, subteam, and individual performance generally improve during training: that student capability to deal with recovery contingencies and emergencies improves; that students generally perform acceptably in the operational job setting and that empirical evidence supports (but does not prove due to the study design) the transfer of training hypothesis; and that students gave the device moderate to high ratings on realism and effectiveness characteristics. It was concluded that device effectiveness could be further improved and that recommendations were worth consideration due to the considerable impact CATCC has on efficiency and safety of carrier recovery operations. Recommendations were made relative to modifications and additions to the device hardware and software; utilization of the device for team training; personnel qualification requirements, including instructor, trainer

"pilot", and student personnel; development of CATCC performance standards; and investigations which would determine recommended training schedules, analyze and evaluate other portions of the naval controller training program, and optimize the controller-display interface and the CATCC system with respect to Naval Tactical Data System (NTDC) capabilities.

62. Mackie, R. R., Kelley, G. R., Moe, G. L., and Mecherikoff, M. Factors leading to the acceptance or rejection of training devices. NAVTRADEVCEN 70-C-0276-1, Contract N61339-70-C-0276, Human Factors Research Inc. Aug. 1972, 166pp. AD 752477.

The use and acceptance by Navy personnel of 16 major training devices were studied in relation to: (1) situational factors affecting training; (2) simulation characteristics of the trainer; (3) instructional characteristics of the trainers; reliability of the trainers; formal and informal communications regarding trainer capabilities; and level of experience of the users in the systems simulated by the trainers. Trainers representing air, surface, and submarine systems were selected for study; the participants included students, instructors, administrative, and maintenance personnel. An acceptance profile technique was developed that appears to be highly diagnostic of the reasons for acceptance or rejection of particular trainers. It was evident that both highly accepted and seriously rejected trainers were represented in the sample. Methods for increasing trainer acceptance are outlined in terms of improvement in specific areas of simulation; improved software; greater qualifications for instructors; improved evaluation of performance; and improved understanding of the purpose, capabilities, and limitations of trainers by the users. The merits of continuing studies of trainer acceptance and the role of a "trainer advocate" are discussed.

63. King, B. C., and Fowler, F. D. Relative effectiveness of two and three dimensional image storage media. Final Report. NAVTRAEQUIPCEN 70-C-0238-1, Contract N61339-70-C-0238, Martin-Marietta Corporation. Sep. 1972, 118pp. AD 754743.

Experiments were conducted to evaluate subjects' ability to perceive the dimensionality of source material used to generate dynamic TV images of simulated military targets. The Dive Approach test series investigated the perception of motion-dependent depth cues during an approach to the target area at

a constant dive angle. The stimulus material used in these behavioral tests were video recordings of runs made in the Martin-Marietta Guidance Development Center (GDC) using 3-dimensional (3-D) and optically simulated 2-dimensional (2-D) target areas. The Constant Altitude Approach test series investigated the perception of motion-dependent cues to dimensionality derived from simulated horizontal flight at various altitudes. Again, the stimulus materials used were video recordings of selected target runs made on the GDC terrain model. The results show that movement parallax normally provides useful depth cues only at very close ranges, both for constant dive angle and constant altitude approach geometries. This finding has significant implications for the design of visual simulation equipment to be used for training. Thus, for problems which require simulation of TV navigation and/or targeting imagery, serious consideration should be given to the use of relatively inexpensive 2-D storage devices for altitudes in excess of 750 feet.

64. Wheaton, G. R., and Mariabella, A. Effects of task index variations on training effectiveness criteria. Final Report. NAVTRAEQUIPCEN 71-C-0059-1, Contract N61339-71-C-0059, American Institutes for Research. Oct. 1972, 87pp. AD 751558.

A feasibility study was undertaken as part of a program to develop quantitative techniques for prescribing the design and use of training systems. As the second step in this program, the present study attempted to: (1) refine quantitative indices employed during earlier research; (2) conduct laboratory research on the effects which task index variation have on training criteria; and (3) support the laboratory results with data gathered in the field. Two laboratory investigations and a field study were conducted. In the first laboratory study, effects of variations in task indices on skill acquisition of a set-up task were examined. In a companion effort, preliminary data were collected on relationships between task index variations and performance during transfer of training. In the field study quantitative task index data, descriptive of a variety of sonar trainers and sonar trainee tasks, were related to ratio estimates provided by instructors on four training effectiveness criteria. Significant multiple correlations were obtained between task indices and speed and accuracy of performance during skill acquisition. Predictor patterns changed over time and between criteria. Set-up task speed was predicted early in training, while errors made were predicted later during acquisition. Similar but more provisional relationships were found during

transfer of training. Speed and, in particular, accuracy of performance during transfer bore consistent relationships to task index values. Support for these general findings was obtained in the field. Significant relationships were established between instructors' judgments of training criteria and trainee sub-task index values.

65. Puig, Joseph A. The training effectiveness of Device 3A105, tracked vehicle driving trainer (M48A3). NAVTRAEQUIPCEN TN-36, Naval Training Equipment Center. Nov. 1972, 31p. AD 754097.

This paper describes a study in the measurement of training obtained by using the Tracked Vehicle Driving Trainer at Camp Pendleton, California. Effectiveness of training in the device compared with training in the M48A3 tank was used to determine transfer of training. The results showed that driver training using the trainer was effective as training in the tank: that the training was accomplished in less than or an equal amount of time using the trainer as compared to using the tank alone; and that the cost of training per hour in the trainer was less than in the tank ($2.10 per hour in the trainer, $6.05 per hour in the tank). In view of the findings of the study, it was recommended that Device 3A105 continue to be used as a trainer for the M48A3 tank on a one-to-one substitution basis.

66. Erickson, H. W., Simpson, D. W., and Stark, E. A. Naval pilot training system study. (Three volumes) Final Report. NAVTRAEQUIPCEN 72-C-0049-1, Contract N61339-72-C-0049, Singer Simulation Products Division. Dec. 1972, 623pp.

This study defined a cost effective program for training Naval fixed-wing pilots during the 1974-1986 time frame. It identified requirements for the Undergraduate Pilot Training program anticipated for that period, and evaluated elements of the current program and the educational and training technologies for their ability to economically fulfill them. The behavior objectives of the future program were defined through the analysis of the flight tasks trained in the present program, likely to be relevant in the future. Major system elements having significant impact on the development of these objectives were identified and recommendations developed for restructuring the program to reduce cost while maintaining current levels of pilot proficiency. Recommendations are submitted to: (1) Revise the preliminary flight training program to provide more training in less expensive aircraft and provide

an improved basis for pipeline assignment; (2) Reduce the variety of aircraft types and models from nine to four retaining the T-2C, the TA-4J and the TS-2A and replacing the T-34B with an instrumented turbine-powered propeller aircraft; (3) Accelerate the procurement of modern ground trainers and flight simulators, making maximum use of automated training and visual and motion simulation; (4) Institute a program to systematically validate and introduce specific study recommendations.

67. Robins, J., Finley, D. L., and Ryan T. G. Training effectiveness evaluation of Naval training devices: an evaluation of the 2F69B ASW weapon system trainer. NAVTRAEQUIPCEN 70-C-0258-2, Contract N61339-70-C-0258, Bunker-Ramo. Dec. 1972, 124pp.

Two separate experiments were performed to evaluate the effectiveness of the Navy 2F69B Weapon System Trainer. These experiments were conducted at the Patuxent River Naval Air Station, Patuxent, Maryland. Training Squadron VP-30 provided the WST aircraft, students and instructor personnel used in both studies. During the first study, experimental data were collected on two classes of students composed of six and seven crews. During the second study, data were collected on two classes of students composed of four and seven crews. The first series of experiments were conducted in the WST. The second series were conducted in both the WST and airborne environments. It was apparent from the experimental data, questionnaire responses, and direct observation of training activities that the most beneficial ASW tactics training occurs in the WST. There were also clear indications that the training received in the WST was transferred in a positive manner to the airborne environment. As a result of these studies it is recommended that the number of WST training sessions be increased and that the number of P3 training flights be reduced.

68. Kolakowski, D. A. Construction of a self-instructional course for the resources management system/research, development, test and evaluation, Navy. Final Report. NAVTRAEQUIPCEN 72-C-0030-1, Contract N61339-72-C-0030, Computer Sciences Corporation. Dec. 1972, 92pp.

A self-instructional course to train cost center managers to work within the Resources Management System (RMS) was needed to implement this new system under the Research, Development, Test and Evaluation, Navy appropriation. To develop this course a

system approach was taken which included: (1) Task Analysis which provided the information needed by cost center managers to perform their job; (2) development of Terminal Performance Objectives which identified the needs of cost center managers in measurable, behavioral terms; (3) development of a Criterion Test which measured the effectiveness of the objectives; (4) development of the Instructional Materials as a self-instructional course; (5) developmental testing which utilized the criterion test to assess the efficiency of the developed materials; (6) validation testing which indicated that the course developed was efficient and valid. The following characteristics resulted from the system's approach to the development of the training package: (1) it presents all aspects of the new RMS; (2) it allows each cost center manager to proceed through the training at his own pace; (3) it contains sufficient feedback and reinforcement to assure the cost center manager's ability to apply the RMS; (4) it contains motivational elements which will increase the likelihood that the cost center manager will choose to apply the RMS.

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